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Description and Biometrics of Variation in Maculation Pattern in Papilio gallienus gallienus Distant (Lepidoptera: Papilionidae)[1]

Donald J. Procaccini and Michael T. Gyves, Department of Biology, Emmanuel College, Boston, Massachusetts 02115

Abstract

Four maculation patterns are commonly found within the discal cell, in each of which line segments OA, Oa_1, a_1A, and a_1B are present. It was found that in the female population line segment a_1A is 6.5% shorter, relative to segments Oa_1 and a_1B, and segment OA is 5% shorter relative to the same segments. Segment a_1A was found to be 1.2% shorter in females relative to line OA. Analysis of maculation pattern(s) of each specimen and collection date indicated a significant variation in pattern frequency throughout the four month period. Three different types of cell banding were identified. This character appears to be randomly distributed with regard to season. A larger sample would be required to determine if a non-random distribution of banding type and sex exists.

The purpose of this study is twofold: first, the description of previously unreported variation in the maculation pattern on the underside of the secondary wing of *P. gallienus gallienus* Distant

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(Fig. 1), an inhabitant of the Congo region of Africa; and, second, the correlation of this pattern with sex and seasonal distribution. A total of 88 specimens, 72 males, 13 females, and 3 damaged forms, from the collection of the American Museum of Natural History, New York City, were analyzed. This represents the largest series of the butterfly in the Western Hemisphere.

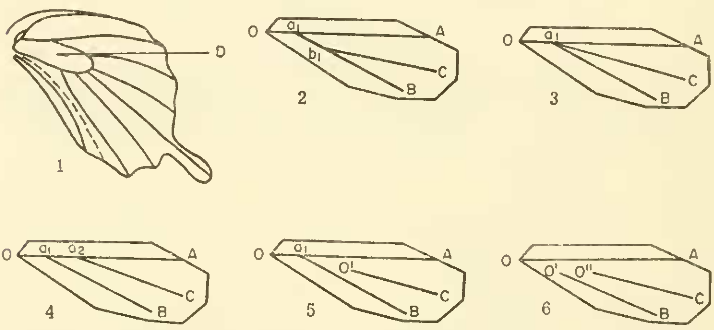
In order to measure the patterns an apparatus was constructed (Procaccini, Marks, and Gyves, 1968) which enables the viewer to manoeuver the illuminated specimen beneath a system of measuring grids until the outline of the pattern is clear. Accurate measurements may then be taken through the grids. The species lends itself to such numerical methods because of the contrast between the deep yellow maculation pattern and the dark brown wing matrix.

Results

Four maculation patterns were commonly found among the 88 specimens (Figs. 2–5). A fifth pattern (Fig. 6) was present only on one wing of one specimen and was excluded from all biometric procedures.

Another character in the discal cell is the presence of a light yellow band which crosses the distal corner of the cell polygon. Three banding patterns, distinguished by the figure formed by the distal cell border and the proximal border of the band, were observed. The first type, termed the major quadrilateral, is a figure formed when the yellow band crosses the cell at two points, the junction of the radio-medial cross vein and the m_1–m_2 cross vein anteriorly and the junction of the medio-cubital and cu_1–cu_2 cross veins posteriorly. The remaining boundaries of the figure are the mi_1–m_2 cross vein, the m_2–m_3 cross vein and the medio-cubital cross vein. The second banding figure, termed the minor quadrilateral, is formed when the yellow band crosses the cell posteriorly at the junction of the medio-cubital and cu_1–cu_2 cross veins and terminates at a point midway through the m_1–m_2 cross vein. The distal boundaries of the figure are the m_2–m_3 and the medio-cubital cross veins. The third type, termed the pentagon, is a figure formed when the yellow band crosses the cell posteriorly at the junction of the medio-cubital and cu_1–cu_2 cross veins and terminates anteriorly in the distal third of the radio-medial cross vein. The other four sides of the figure are provided by the remaining portion of the radio-medial vein and the m_1–m_2, m_2–m_3, and the medio-cubital cross veins. Cell banding as opposed to the maculation pattern is identical on both wings.

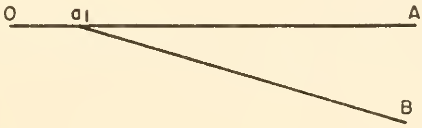
Correlation between pattern frequency and season.—The butterflies were collected during a four month period and all but two specimens bore a date tag. The problem of correlating month with pattern was somewhat complicated by the fact that patterns may differ on each wing of the same specimen. The



FIGS. 1–6. Maculation pattern in *Papilio gallienus gallienus* Distant. 1. D, discal cell. 2. Pattern A → B → C. 3. Pattern A → BC. 4. Pattern A → B + C. 5. Pattern A → B/C. 6. Pattern A/B/C.

solution was to treat each butterfly as possessing two pattern characters. The result of this analysis is shown on Graph 1. It is clear that there exists a significant relationship between the concentration of pattern types and month. The changing frequencies do not represent chance fluctuations but may indicate seasonal variants of a polymorphic population (Procaccini and Marks, 1967).

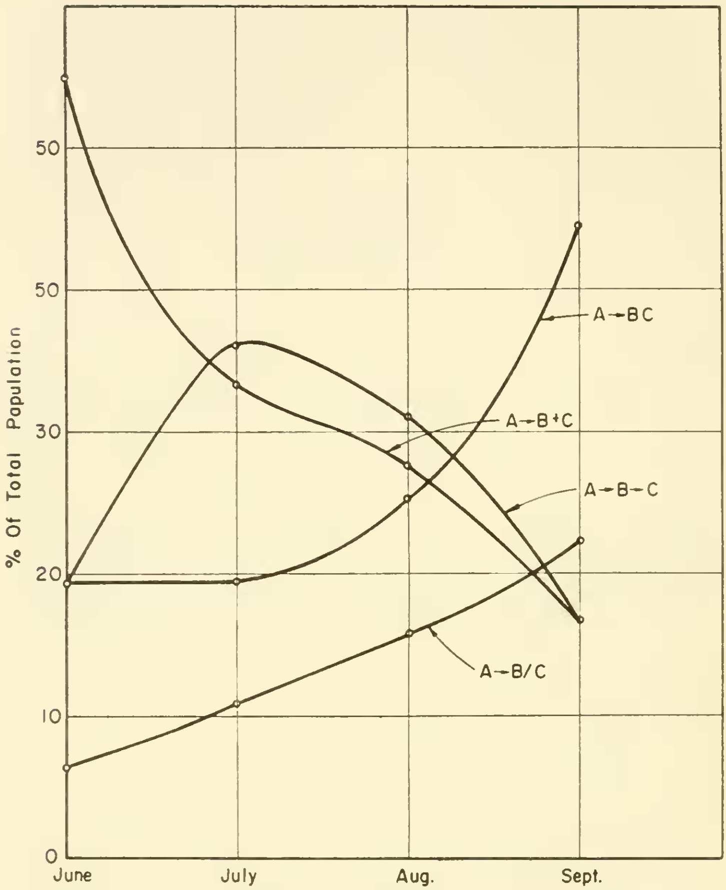
Correlation between pattern size and sex.—In order to link sex with the size of the maculation pattern only those segments were considered which were found in all patterns. Therefore segments of Oa_1, a_1A, OA, and a_1B were compared since the line terminating at point C differs in each of the pattern types.



The arithmetical mean of each of these segments was calculated and twelve ratios were set up between the various segments in each sex. The ratios were analyzed in sets of three, each set illustrating the values of the three segments relative to the fourth. The numerical values of the relationships are given in Fig. 7.

Segments Oa_1 and a_1B possess the same ratio in both males and females. This is most apparent in sets 3 and 4. With this equal ratio there is a basis of comparison between male and female patterns. From this point, it was determined that the line segment a_1A is 6.5% shorter and OA is 5% shorter in the females, relative to segments Oa_1 and a_1B. These relationships are most clearly seen in sets 3 and 4. Segment a_1A of set 1 is likewise shown to be 1.2% shorter in the females relative to line segment OA. The most striking difference between the patterns of the two sexes is the size of segment a_1A relative to the other three segments. This triple relationship is best seen in set 2. In this set the higher value in the female indicates a lower relative value for segment a_1A. The standard deviations of the means were low in both sexes; 1.3% for the males and 2.7% for the females.

Correlation between banding type, month, and sex.—An analysis of the relationship between cell banding type and month proved inconclusive. The banding types seem to be randomly distributed without regard to season. An analysis of the relationship between sex and banding type showed that 10 of the



GRAPH 1.—Correlation between pattern frequency and season in *Papilio gallienus gallienus* Distant.

13 females belonged to the major quadrilateral type and that the banding type termed the minor quadrilateral was found in 6 specimens, all male. Because of the small number of specimens in each type category, these results cannot be considered as predictive of a larger sample. The possibility exists, however, that the character is non-random with regard to sex.

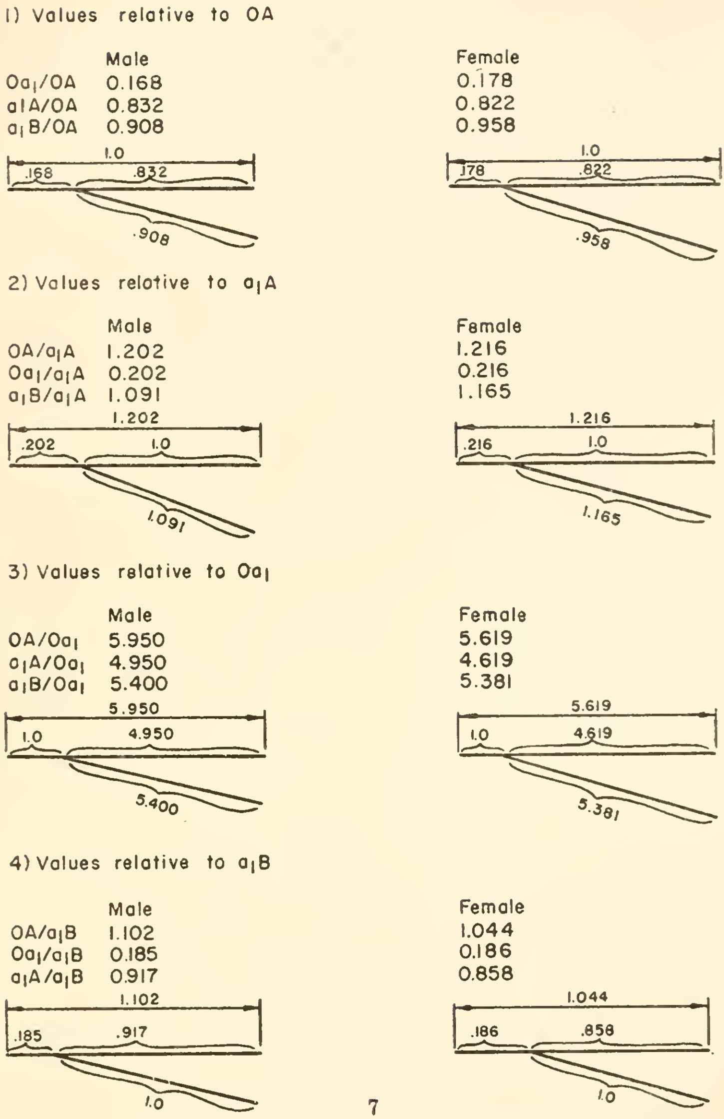


FIG. 7. Correlation between pattern size and sex in *Papilio gallienus gallienus* Distant.

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Concerning the True Identities of Gosiphilus and Chomatobius, with Redescription of the Latter's Type-Species (Chilopoda: Geophilomorpha: Himantariidae)[1]

R. E. CRABILL, JR., Smithsonian Institution, U. S. National Museum, Washington, D. C.

In 1870 Humbert and Saussure proposed the new generic name *Chomatobius* for the reception of two unrelated species, *Geophilus mexicanus* Saussure, 1858, and *Chomatobius brasilianus* Humbert and Saussure. It is established now that *brasilianus* is an Oryid, and although Attems in his 1929 monograph referred *mexicanus* to the Oryid genus *Orphnaeus,* the species is actually an Himantariid assignable in my 1959 generic key to *Gosiphilus* Chamberlin.

In 1959 I did not include *mexicanus* within my catalogue of New World Himantariidae, because its original and all subsequent descriptions were either unclear or misleading and as such seemed to fortify Attem's disposition. Like Attems, I had not seen the species' holotype. Upon examining the Saussure specimen in Geneva in 1960, I found it to be an Himantariid clearly assignable to *Gosiphilus.*

At the time of the proposal of *Chomatobius* neither species was in any way designated as the type of the genus. The earliest

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